times to the northeast, with a velocity of about 9 miles an hour, stiffened quickly and came directly from the north, lowering the temperature 6° in less than five minutes.

The indications were that the temperature would fall much lower, but suddenly dark, vaporous-looking clouds appeared in the extreme southwest; with them simultaneously a strong gale from the same quarter, blowing at the rate of at least 40 miles an hour. The gale seemed to meet the wind coming in from the north, and drove it in a whirl directly toward the northeast, across the prairie, in a funnel-shaped cone, plainly perceptible for a long distance by the dust gathered. The temperature quickly rose to 58°, the maximum recorded for this date, and the chinook had mastered the cold wave.

Under some circumstances a rise of from 0.25 to 0.75 inch in pressure will produce colder weather, but under other conditions, such as those that prevailed on this occasion, a rise in pressure will produce a rise in temperature, or chinook winds, over the northwest portions of the United States. The rise in temperature in the latter case, accompanying a rise in pressure, can only be ascribed to dynamic heating.

The following table, showing pressure and temperature at 8 a. m., seventy-fifth meridian time, from November 8 to 18, inclusive, at the regular Weather Bureau stations, in the region now under consideration, illustrates the conditions prevailing during this first chinook in the autumn of 1895:

Nov. 1895.	Portland.		Roseburg.		Seattle.		Baker City.		Spokane.		Helena.	
	Bar.	Temp.	Bar.	Temp.	Bar.	Temp.	Bar.	Temp.	Bar.	Temp.	Bar.	Temp.
8	30.36	34	30.34	26	30.36	46	30.32	30	30.42	32	30.30	34
9	30.16	34	30.18	32	30.10	42	30.26	26	30.26	32	30.30	28
10	30.12	48	31.14	46	30.02	48	30.04	34	30.04	36	30.22	26
11	30.36	36	30.30	36	30.32	40	30.22	32	30.32	30	30.28	28
12	29.86	36	29.90	38	29.98	40	29.96	20	30.02	24	30.10	24
13	30.34	44	30.40	36	30.26	40	30.34	20	30.30	32	30.12	34
14	30.40	50	30.48	46	30.28	54	30.38	32	30.32	42	30.32	42
15	30.62	56	30.62	52	30.50	56	30.62	32	30.44	50	30.30	54
16	30.58	46	30.52	48	30.56	48	30.60	28	30.50	42	30.32	50
17	30.32	44	30.30	42	30.26	48	30.38	32	30.18	40	30.08	44
18	30.36	44	30.30	42	30.36	50	30.32	30	30.26	38	30.00	50

[NOTE.—A general explanation of the relation of chinooks to areas of high pressure was given in the MONTHLY WEATHER REVIEW for 1894, on page 77, and a further illustration on page 444. In a recent letter (February 3, 1896) Mr. Pague says:]

It is not, as I understand, admitted by all that chinook winds occur west of the Cascades. From my knowledge of conditions over the Pacific northwest I maintain that perfect forms of chinooks occur west of the Cascades and Rocky Mountains as well as to the east of the Rocky Mountains. The degree of moisture in the chinook winds varies with the conditions and the country over which they blow (at Walla Walla, Wash., for example, sometimes the very dry chinook occurs, which causes the snow to disappear without leaving any water behind); again, under another chinook the snow is melted and little evaporation takes place. The explanation of this is as follows: In the first case, there is little or no movement of the upper currents from off the ocean, hence the expansion and heating of the air will allow dry air to be brought into contact with the snow which evaporates as it melts. In the second case, there is a decided movement of air from the ocean inland and the dryness of the chinook is overcome by the vastness of the supply of moist air. The Rocky Mountains bar the moist air and, therefore, to the east of the Rockies the dry chinook usually prevails.

From November to March the mean temperature over Washington and Oregon is materially higher than it is to the east of the Rocky Mountains over the country having the same latitude. This mild winter temperature is generally ascribed to the proximity of the ocean and to the Japan current (Kuro-Sivo). While the ocean does modify the otherwise low temperature, yet the mean temperature is as much or more influenced by the dynamic heating of the air or chinook winds. If, during the winter season, the low is off the California coast the cold air on the northeast flows southeastward and gives the low temperatures over Washington and Oregon; if the low is passing eastward over British Columbia and a high is central about Salt Lake City, then the dynamic heating, or chinook winds, prevail and high temperature occurs.

In these two instances the oceanic influence is only indirect. Comparatively high temperatures also occur in connection with lows moving from off the California coast northward along the Oregon and Washington coasts, gradually extending inland; in this latter case the oceanic influence on the mean temperature is of direct effect.

Low mean temperatures occur from November to March when the lows are frequent and move southward along the coast to the Columbia River or farther south (they seldom move much to the south of the Columbia). Mean temperatures above the normal occur when the lows pass eastward at a high latitude, about British Columbia. In the latter case the chinook, or dynamic heating, prevails.

SPECIAL CONTRIBUTIONS.

A WEATHER BUREAU KITE.

By Prof. C. F. MARVIN, U. S. Weather Bureau (dated March, 1896).

In this age of progress even the boy's kite is made to serve a useful purpose, and investigations are now being made under the special direction of Prof. Willis L. Moore, Chief of the Weather Bureau, with a view to employing kites for the purpose of sending meteorological instruments to high elevations, so as to gain better information respecting the nature and causes of atmospheric phenomena than can be done from observations at the surface of the earth.

We are sometimes told by naturalists and others that man is a descendant of the monkey, and that by processes of evolution the tail, among other characteristics, has been entirely dispensed with. Exactly this same sort of evolution is going on before our eyes to-day. Kites are rapidly losing their tails, and those of the future are sure to be made altogether without tails. Among the great variety of sizes and forms tried by the Weather Bureau, none have tails.

The one of which a detailed description is given in this article is selected for the reason that it is among the best, and at the same time is not very difficult to make.

A word here respecting the origin of kites of this character will be interesting to many readers, who will be surprised to find that as early as 1866 Wenham perceived the advantages of superposing two or more planes one above the other for the purpose of securing a large extent of sustaining surface for artificial flying machines. After many years, Hargrave, an indefatigable and very able inventor of flying machines in Australia, embodied Wenham's idea of superposed planes in his odd-looking box-shaped kites. The resemblance of these kites with their thin walls to a honeycomb with the ends of the cells open seems to have suggested to Hargrave that the kites be called cellular kites. Some made by him were employed for the purpose of sustaining himself at considerable heights in the air in order that he might the better conduct certain investigations.

Finally, in order to determine whether kites of the Hargrave type were suited to the needs of the Weather Bureau work, Mr. S. A. Potter, in October, 1895, made several cellular kites of different sizes. The trials were so successful from the first that kites of this type have been employed exclusively in subsequent investigations. Mr. Potter, it seems, was the first in the United States to successfully construct and fly kites of this kind. After a few trials he hit upon an important modification whereby the construction was greatly simplified, and the strength and lightness increased. This kite is described below and shown in the illustrations on Chart VIII.

The following description of a kite of convenient size is given with great minuteness, for the reason that there will probably be many observers who will be delighted and instructed to possess and fly one of these seemingly odd-shaped cellular kites.

When flown in a good breeze of 10 miles or more per hour the kite will pull quite as much as one can comfortably control without the aid of a special reel for managing the string.

Fig. 2 represents the kite as it appears when a short distance up in the air.

The kite contains 15 square feet of cloth, and should be flown with strong hemp twine. The exact kind of string is known on the market as "Cable-laid Twine No. 24." The cloth may be either of silk, or quite as well, of the finer and lighter grades of cotton, such as nainsook, lonsdale cambric, calico, etc.

It is very important that the wood used for the sticks be light and straight grained. Soft white pine is probably the best and most available material. Spruce is stronger, but more difficult to procure:

The following material is required in its construction:

4 pieces of pine, ¼ inch thick, ⅝ inch wide by 44 inches long. These are the sticks which appear at the top and bottom and at the side edges in the figure, and extend from one piece of cloth to the other:

2 short struts, ¼ inch thick, ⅝ inch wide and 15 inches long.

2 long struts, ½ inch square by about 38 inches long, the exact length must be determined after the cloth has been put on:

2 strips of cloth, hemmed on both edges, 81 inches long and 13 inches wide after hemming:

12 wooden cleats will be needed, some 1-inch wire brads and a few 2-ounce tacks.

Having provided the above material the first thing is to make a frame such as shown in Fig. 3. The top and bottom sticks are two of the long thin sticks, the uprights are the two short struts given in the list above. Small cleats must be nailed with brads on the top and bottom of each strut in order to clasp the long pieces, as shown in the full-size view, Fig. 4. When the struts are finally in place, 7 inches from the ends of the long sticks, brads must be driven through the points so as to hold the long sticks from slipping in the fork. To make the frame rigid, wire ties must be added, as shown in Fig. 3. Soft iron wire used by tinners for holding stovepipes, etc., will answer. The wire should be passed through a small hole in the wood and fastened by twisting around the long pieces, *not to the struts*. In the absence of wire string may be used. The length of the wires must be just right so that the angles between the long pieces and the struts are right angles.

The next step is to prepare the cloth covering. The material is generally a yard wide. Of this, take a piece just 81 inches long, the ends should be torn, not cut off. They will then be true and square with the fibers of the cloth. The selvedge edges had best be hemmed, and this should be done before tearing the cloth lengthwise. After hemming, lay out one end of the cloth smooth and flat and measure from each hem inward 13½ inches. Cut the cloth at the marks for a distance of about half an inch and then tear the cloth entirely through, lengthwise, twice, thus forming two long strips, the raw edges of which must be hemmed. Lay out, in turn, each end of each strip smooth and flat on a table, and with a straight-edge draw a pencil line across the cloth just ½ inch from the end. The two ends of a strip are next brought together, overlapped and sewn together with two rows of stitching so that the two pencil marks coincide exactly. The cloth should now be in the shape of two endless bands.

The next step is to find the points at which the sticks are to be attached. Stretch each cloth band separately out smooth and straight over two thin sticks run through inside the band. It is well to make the seam in the band come exactly over the edge of one of the strips. When smooth and evenly stretched, draw a pencil line across the band exactly in the middle, where it turns around the edges of each stick. If the seam is placed at one stick the line already drawn should answer. Now, shift the band part way around on the sticks, so that the two pencil lines across the cloth will be exactly even with each other. These lines will then be exactly midway between the sticks. When this adjustment of the cloth has been accomplished, draw two more pencil lines at the edges of the sticks as before. Time and care spent in laying out these lines accurately on the cloth, so as to divide it into four exactly even portions, *when stretched*, will be well repaid in the even flying of the kite.

The cloth bands are next fastened to the frame shown in Fig. 3 by small 2-ounce tacks, driven exactly through one of the pencil lines which is placed directly over the edge of the frame. One edge of the band is made to come just even with the ends of the long sticks of the frame. The second band is attached at the opposite end of the frame with the edge of the cloth even with the ends of the sticks. Five or six tacks are sufficient on each mark, and when the cloth has been fastened to one edge of the frame the opposite mark on the cloth must be tacked to the opposite edges of the frame.

There are now two remaining lines on each band of cloth. At these marks the cloth is tacked to the edges of the two long thin strips of wood, in the same manner as just described, the edge of the cloth being fastened even with the end of the stick in each case. In fastening the cloth the pencil lines should be placed exactly over the middle of the edges of the sticks.

All that remains is to finish up the two long cross struts. On one end of each of these cut out a notch, as shown in Fig. 5 and nail on a cleat so that it shall appear as shown in Fig. 6. Place the fork thus formed over one of the loose strips attached to the cloth at the side of the kite, and stretch the band taut. Make a mark on the unfinished end of the strut, showing the depth at which to cut a notch and form a fork like the one shown in Fig. 6, which, when finished, will clasp the remaining loose stick of the kite, and stretch the cloth up taut as a drum head.

When the long struts are placed finally in position, they should be forced down against the short upright struts and the two firmly tied together by wrapping with waxed string. A brad should be nailed through the cloth and the forks at each end of the long struts so that this cannot slip on the side sticks.

The kite is now ready for the bridle or bellyband, and it makes no difference which side of the kite is uppermost, or which cell is made the forward one. In some respects it is best to dispense with the bridle and fasten the string directly to the lower stick of the truss, shown in Fig. 3, but as the best point can scarcely be located without trial and as new holes must be made in the cloth if the string is shifted, the former arrangement is more convenient. The bridle is made of a piece of strong twine and is tied to the frame, as shown in Fig. 3. Small holes are pierced in the cloth so that the twine may be run through, around the stick, and out. The length of the twine must be such that when drawn taut and laid over against the cloth of the kite the bellyband appears as shown at *A*, *B*, *C*, Fig. 7, which also shows how the main line is fastened. The correct knot to make in tying the main line to the bridle is the well-known weaver's knot, with a loop, shown in Figs. 8 and 9. It cannot possibly slip and yet can be untied simply by pulling the loose end of the string. This is desirable as the point of attachment needs to be changed sometimes to get the best effect. A foot or two of string should be left tied to the bridle so that the point of attachment need not be changed when the kite is taken down and detached.

Those who desire to get the very best results will find it an advantage to round over all the edges of the sticks, not only that the cloth may not be injured but that the sticks may weigh less and cut through the air with less resistance than if left with perfectly flat surfaces. This applies particularly to the struts, cleats, etc. When completed the kite should weigh about 16 ounces.

Finally, the kite can be made much more rigid by fitting it with a set of string or wire ties. These may be placed outside the cloth and should connect all the corners of the interior frame work.

To fly the kite.—Unless the wind is very strong the safest way to start the kite in flight is to run out 150 feet or so of twine while the kite is held by an assistant. When all is ready the assistant may toss the kite upward a little in the direction in which it is to go. It will take care of itself afterwards. It is important the kite be cast off directly in line with the wind, otherwise it may seem to dart badly. The object of this method is to get the kite quickly above the irregular and greatly disturbed air currents near the ground, and give the kite more room to dart about with less danger of striking anything until it gets into steady currents. When fairly up these kites may sweep a little from one side to the other, but if they ever dart or turn over, there is something radically wrong, probably due to an uneven distribution of the cloth surface, or some permanent distortion of the frame work. Sometimes the weight of the wood varies and one side is heavier than the other. This should be corrected by weighting the light side with a small strip of sheet lead, or otherwise.

If the wind is very light a finer twine may be used in flying, and it may be necessary to run a little with a long string out, in order to get the kite into upper and more rapidly moving currents.

When the wind is very strong drop the ball of twine on the ground so that the cord can pay out rapidly and let the kite go up directly and quickly from the hand.

Tandem kites.—Several kites can be sent up on the same line. When an additional kite is to be sent up it must be first carried out, say 100 feet attached to a separate line of this length, the end being tied to a loop formed in the main line. When all is ready the kite is tossed up as already described.

Fine wire is the only suitable material to be used for flying kites at the very greatest elevations. Steel piano-forte wire capable of sustaining over 200 pounds will weigh about half as much as hemp twine of the same strength. A still more important advantage, however, is the fineness of the wire, the diameter of which will be about one-fifth that of twine. The wind presses against the coarse twine with a seriously detrimental force, whereas the fine wire cuts through with but little resistance. The wire employed by the Weather Bureau is just about the thickness of an ordinary pin.

In Franklin's famous kite experiments, in which he drew lightning from the clouds, the wetted string became the conductor of the electricity, and, in recent experiments a fine copper wire was used with the kite string, the former conducting the current and the latter flying the kite. When wire alone is used the electrification is considerable at all times, and with two or three thousand feet of wire out, sparks an inch or more long may be drawn from the wire.

When recording meteorological instruments are sent up they are attached to the wire below the kites.

The proportions of the kite may be varied considerably without impairing its flying qualities, and the size can be changed to any extent.

FLUCTUATIONS OF THE WATER LEVEL IN THE GREAT LAKES.

By Ossian Guthrie, C.E., Chicago, Ill. (dated Feb. 14, 1896).

The unprecedented and long continued low stage of water in the lakes has been the occasion of much discussion, and to those interested, but unfamiliar with their irregular source of supply, has been the cause of much alarm; and added to this natural cause the proposition of Chicago to divert 600,000 cubic feet of water per minute through her drainage channel, now nearly completed, has greatly increased the popular anxiety.

I shall endeavor to show that neither the present low stage of water nor the proposition to divert 600,000 cubic feet of water per minute through the Chicago drainage canal need cause any serious alarm, but on the contrary, I shall encourage the hope that ultimately there will result a greatly improved condition of the lakes for navigation.

The same varieties of trees now growing in the Lake Region were growing soon after the close of the Glacial epoch; hence we conclude that no climatic change has taken place during the past several thousand years. If this conclusion is well founded, the rainfall will continue, and as the lakes are supplied entirely by the precipitation that falls upon the area of their basins, their levels will be maintained as heretofore. If the rainfall is heavy or light the stage of water in the lakes will be correspondingly high or low, as has invariably been the case heretofore, although as a rule the effect of increased or diminished precipitation has been seen the following year, but not always so. The year 1876 was one of heavy rainfall and of high stage of water. In the latter part of the year Lake Michigan reached 2.56 feet above datum. The maximum effect of a heavy snowfall after January 1, followed by early and heavy rainfall, would undoubtedly be seen the same year, while the same amount of precipitation in reversed order would not be seen until the following year.

The Chicago drainage channel diverting 600,000 cubic feet of water per minute [for a whole year] would reduce the level of Lakes Michigan and Huron a fraction less than 3 inches in a year, but the peculiar annual rise and fall of the lakes would reduce this effect by a large percentage, especially during the season of navigation. On an average these lakes are 14½ inches lower at the end of winter than in July. Now suppose the drainage channel had drawn their level 3 inches last year, the flood of next spring would flow directly into this void and restore the levels of last year instead of being wasted in an excessive spring outflow over Niagara Falls, and we would begin on the second year's drawing substantially where we began the first. But notwithstanding these arguments the public has become greatly excited, and the subject has been discussed as it never would have been under ordinary conditions, and consequently the fluctuations of the lakes, their source of supply, and their past and future history, are now better understood than ever before. We find upon investigation that a dam at the outlet of Lake Superior 5 inches high would hold back a supply for the Chicago drainage channel for a year, and that dams or controlling works can be constructed at the outlets of lakes Superior, Huron and Erie, which would not only maintain a nearly uniform stage of water throughout the season of navigation, but also nearly tide us over a short series of dry years with water which now goes to waste. As an illustration, the water power of the Merrimac River would be of little value without her artificial storage basins for flood water. This idea is by no means new, but public attention has been focused upon a prodigal waste of such magnitude that it has become a matter of national concern. Let me give you a few figures: The total basin area of the lakes contains about 230,000 square miles. In round numbers an acre is 209 feet square. There are 640 acres in a square mile, and upon each acre from 20,000 to 25,000 barrels of water annually fall.

The belief is quite common that the lakes rise and fall through a uniform series of seven years. This belief is absolutely without foundation. The fluctuations are as irregular

Chart VIII. Illustrating Cellular Kites.

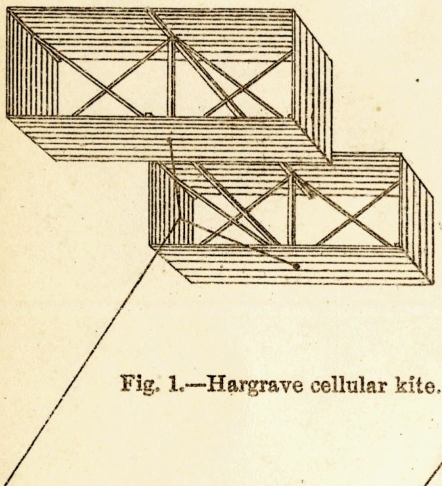

Fig. 1.—Hargrave cellular kite.

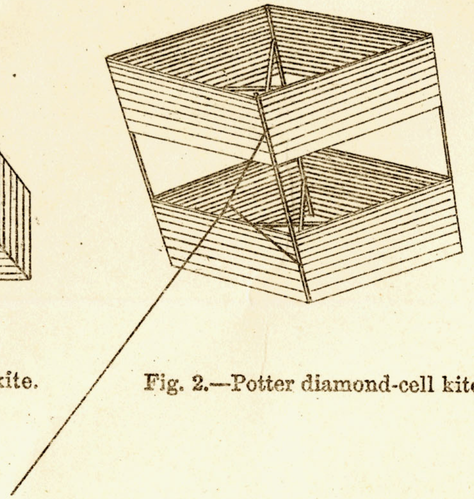

Fig. 2.—Potter diamond-cell kite.

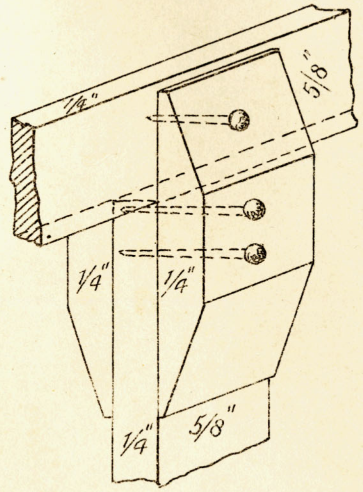

Fig. 4.—Fork on strut.

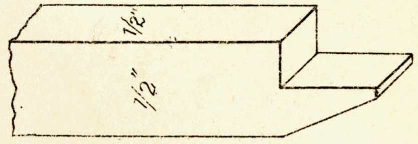

Fig. 5.—Notch in long strut.

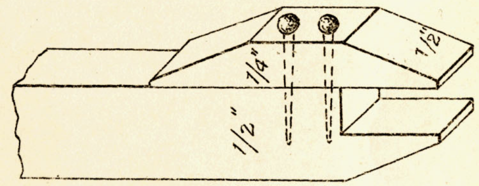

Fig. 6.—Fork on long strut.

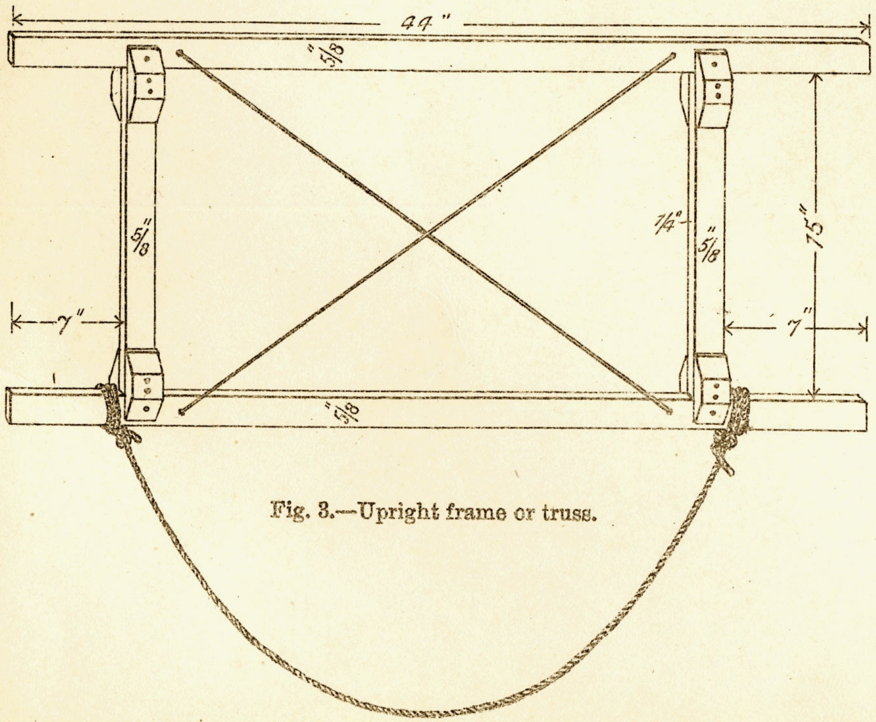

Fig. 3.—Upright frame or truss.

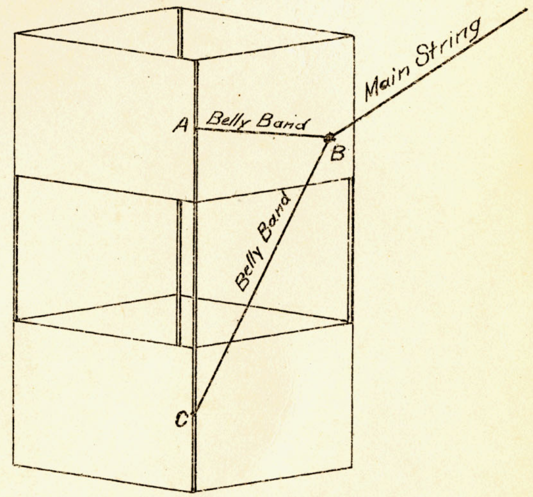

Fig. 7.—Arrangement of bridle.

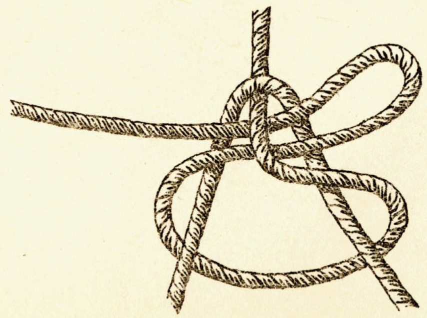

Fig. 8.—Weavers' knot (loose).

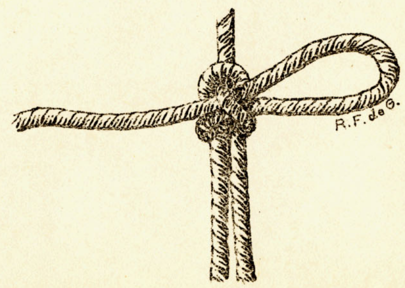

Fig. 9.—Weavers' knot (drawn tight).